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(71) Applicant
Brother Kogyo Kabushiki Kaisha

(Incorporated in Japan)

15-1 Naeshiro-cho, Mizuho-ku, Nagoya-shi, Aichi-ken, 467, Japan

(72) Inventor
Mitsuo Yamane

(74) Agent and/or Address for Service
J A Kemp & Co
14 South Square, Gray's Inn, London, WC1R 5LX, United Kingdom

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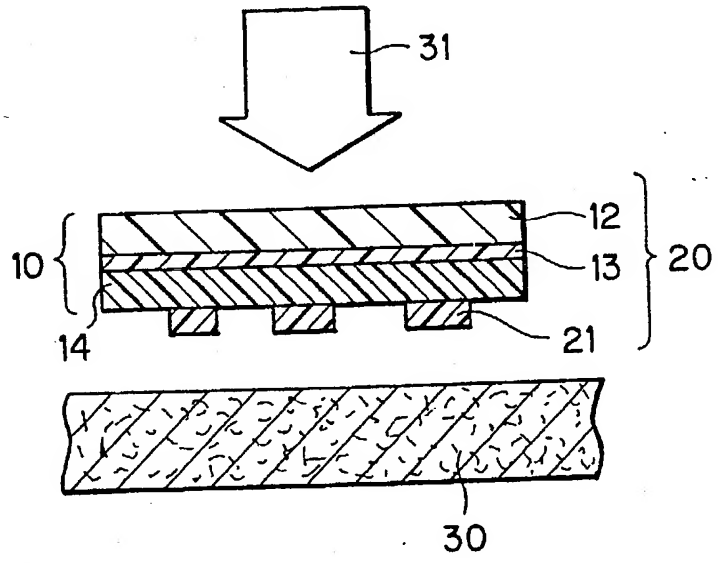
(54) Thermal transfer printing

(57) A printing method includes an ink image forming step and an ink image retransferring step. In the ink image forming step, an ink image (21) is formed on a hot-melting type adhesive layer (14) of a transfer sheet (10) by using a heat-sensitive image transfer type recording device. In the image retransferring step, the ink image (21) and the hot-melting type adhesive layer (14) are transferred onto an image receiving member (30) such as a cloth by heatedly pressing the transfer sheet (10).

FIG. 4



At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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FIG. 1

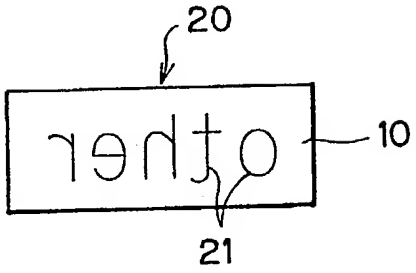


FIG. 2

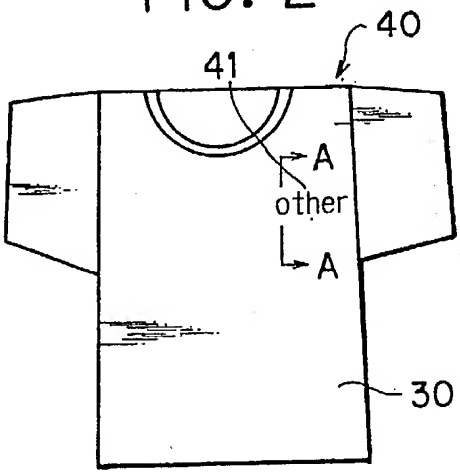


FIG. 3

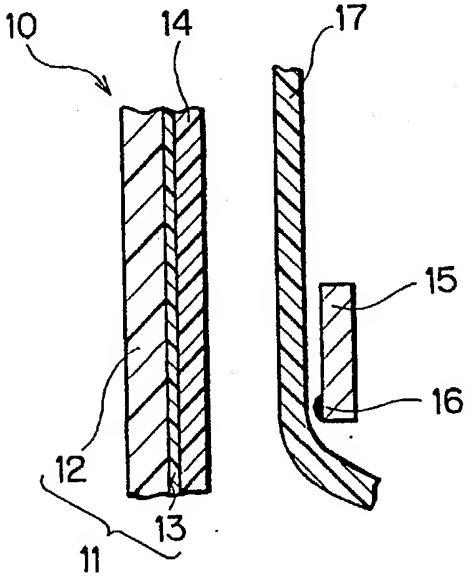


FIG. 4

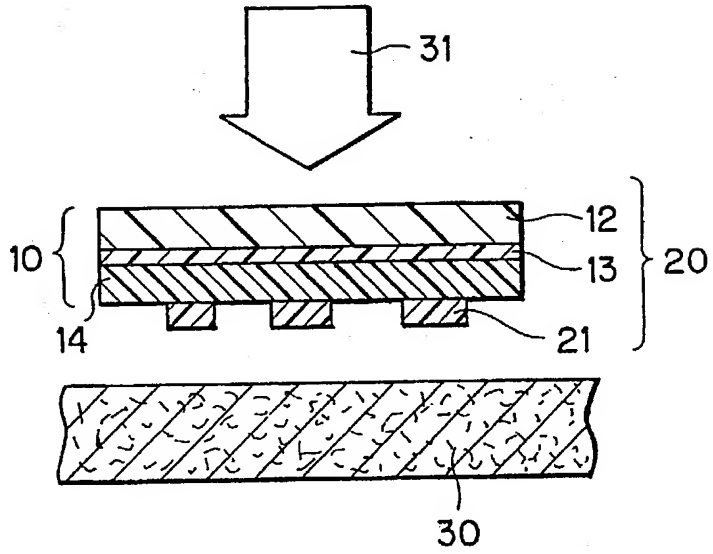
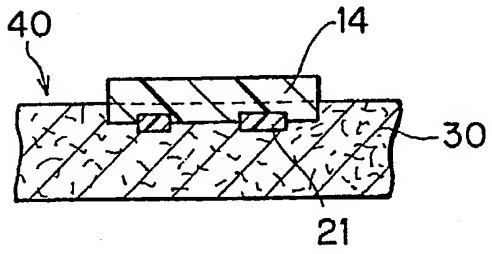


FIG. 5



IMPROVEMENTS IN, OR RELATING TO, THERMAL TRANSFER PRINTING

The present invention relates to a printing method and transfer sheet for printing an image on an image receiving member such as cloth, paper and so on, and more particularly, to the printing method capable of easily printing any desired heat-sensitive transfer image formed on a transfer sheet onto the image receiving member by retransferring the image from the transfer sheet onto the receiving member.

Conventionally, in order to print images of characters and pictures on an image receiving member such as cloth, paper, wood, metal, plastic, ceramics and more particularly on wears and handkerchiefs, users may generally buy a ready-made print material such as a commercially produced applique to thermally print the image of the print material on the image receiving member by an iron, or the users may previously prepare a master plate to print the image on the receiving member by a screen printing method. Alternatively, users may ask for a speciality store to produce the print material. When user personally intends to print the characters and pictures those being not commercially produced on the material, printing process will become complicated, and printing cost will be extremely increased.

In order to resolve the above problem, a printing

system using an electrostatic copying machine was proposed as described in Japanese Patent Application Kokai No. 60-230899. However, since the electrostatic copying machine used in this system is so remarkably expensive that users can not individually get this machine, users must go to the office or store in which this copy machine is set to make the print. In this connection, this system is not available for personal use.

Even if some user can easily use such copying machine, the thermal fixing process of this copying machine restricts the sheet on which a toner image is to be formed and fixed by this fixing process. For example, thermomelting type and thermosoftening type sheets will cause problems at the thermal fixing unit of the copy machine. These sheets will be softened or melted at a heating roller of the unit and adhered thereto or deformed by the pressure of the roller. Therefore the material of the sheet to be printed must be strictly selected.

In addition to the above problems, the copying machine always requires an original for printing the letters or picture images on the material to be printed. Particularly with respect to characters, required characters must be collected and rearranged in desired configuration by cutting and patching them for suitable layout, and the transferable image must be prepared by copying the arranged characters.

This requires a complicated process.

With these problems in mind, it is a primary object of the invention to provide a printing method adapted for cloth, paper and so on in an easy manner. Particularly, the object of the invention is to provide a printing method capable of easily printing any desired print original such as characters and pictures on an image receiving member without any complicated process such as rearrangement of the print original and at a low cost.

These and other objects of the invention will be attained by providing a printing method for printing an image on an image receiving member comprising the steps of: transferring an ink image on a transfer sheet comprising a hot melting type adhesive layer to provide a print sheet, and retransferring the ink image and the hot melting type adhesive layer onto the image receiving member by heatedly pressing the transfer sheet to thereby provide a final print on the receiving member.

According to the printing method of the invention, the heat-sensitive image transfer type recording device produces image data. An ink image is thermally transferred to a hot-melting type adhesive layer of a predetermined transfer sheet from a thermotransfer ribbon of the device in response to the image data made by the device. This trans-

ferred ink image formed on a print sheet is easily retransferred onto a material such as cloth by applying a heat and pressure to the rear surface of the transfer sheet opposite the ink image by means of heating and pressing means such as an iron.

The invention will be further described by way of non-limitative example, with reference to the accompanying drawings, in which:-

Fig. 1 is a front view showing one example of a print sheet in which the ink image is transferred onto a transfer sheet according to the present invention;

Fig. 2 is a front view showing the print image formed on the receiving member after heating and pressing step according to the present invention;

Fig. 3 is a cross-sectional view showing heat transfer process for transferring an ink image onto the transfer sheet according to a first embodiment of the present invention;

Fig. 4 is a schematic cross-sectional view showing image retransfer process for retransferring the ink image of the print sheet onto the receiving member by the application of heat and pressure according to the first embodiment of this invention; and

Fig. 5 is a cross-sectional view taken along the line A-A in Fig. 2 according to the first embodiment of this invention.

A printing method according to one embodiment of this invention will be described in detail with reference to Figs 1 through 5.

The printing method employs a heat-sensitive image transfer type recording device such as a heat-sensitive image transfer type printer, typewriter, word-processor, and the like which are widely used in recent years. With employing the device, any desired image can be transferred on a transfer sheet and the image on the transfer sheet can be thermally retransferred onto a receiving member such as cloth, paper, wood, metal, plastics, ceramic, and the like.

Referring first to Fig. 3, a transfer sheet 10 includes a base sheet 11 and a hot melting type adhesive layer 14. The base sheet 11 includes a base substrate 12 and a releasable layer 13 on which the hot melting type adhesive layer 14 is formed. Onto a surface of the hot melting type adhesive layer 14, a desired transferable ink image is thermally transferred in a real image or a mirror image by a heat-sensitive image transfer type device. More specifically, any desired characters or picture image is input into a heat-sensitive image transfer type recording device such as printer, type writer or word processor through a key board or a mouse of the recording device. The recording device has a thermal head 15 and a heater member 16. The

heater member 16 generates heat in response to the input signal.

An ink ribbon 17 is positioned between the thermal head 15 and the hot melting type adhesive layer 14 of the transfer sheet 10, and the ribbon 17 is heated by the heating member 16 so that the ink image corresponding to the heated position of the ink ribbon 17 is transferred to the hot-melting type adhesive layer 14. For the ink ribbon 17 used to heat-sensitively transfer the ink image on the transfer sheet 10, ordinarily used ink ribbon mainly containing wax or resin ink can be used without any troubles. Thus desired transfer image can be formed on the transfer sheet 10.

In order to effectively form such thermally transferred image on the transfer sheet 10 by using the heat-sensitive image transfer type recording device, various factors of the recording device should be adjusted such as the position or configuration of the heating member 16 of the thermal head 15, the winding torque of the ink ribbon 17, the contact pressure of the thermal head 15 to the ink ribbon 17, the attachment angle of the thermal head 15, the energy supplied to the thermal head 15, the printing speed of the thermal head 15, and the like. Incidentally, Fig. 3 shows the thermal head type heat-sensitive image transfer recording device whose heating member 16 is composed of a

plurality of resistors (heating elements) which are selectively supplied with electric power for selective heat generation. However, the invention can also employ an electric conducting type heat-sensitive image transfer recording device in which an electric conducting layer is set on the ink ribbon 17 and electric power is concentrically supplied to the desired point of the electric conducting layer through a needle electrode to heat the corresponding conductive layer for the image transfer.

The desired ink image thermally transferred on the hot-melting type adhesive layer 14 of the transfer sheet 10 is retransferred together with the hot-melting type adhesive layer 14 onto a final receiving member 30 by applying predetermined heat and pressure to the rear surface of the transfer sheet, i.e., to the base substrate 12. In this system, since the ink image and the hot-melting type adhesive layer must be finally remained on the receiving member, the base sheet 11 must be easily separated from the adhesive layer 14 regardless of the hot or cool state of the adhesive layer 14 after the retransfer step. In this respect, releasable or separable property between the base sheet 11 and the adhesive layer 14 must be properly adjusted.

The base sheet 11 of the transfer sheet 10 includes the film like substrate 12 such as paper, metal foil, plastic film or the like and the releasable layer 13 coated

on one or both surfaces of the base substrate 12. The plastic film used for the base substrate 12 is made of a material selected from polyethylene terephthalate, polyethylene, polypropylene, polyamide, polyimide, fluoro resin, polyvinyl chloride, polysulfone, polycarbonate, ABS resin, or the like. Further, as more preferable mode for improving in heat resistance at the heating and pressing step, the invention may employ various laminated films including two plastic films, and a combination of paper film and metal foil. Further, an additional heat resistance layer can be incorporated into the base substrate 11.

For the releasable layer 13, well known releasable agent can be used, which is preferably selected from one or at least two of silicone resin, fluoro resin, polyolefin resin, and paraffin wax.

Thickness of the base sheet 11 of the transfer sheet 10 is preferably 20 micro meters to 250 micro meters, more preferably 25 micro meters to 150 micro meters in due consideration of convenience in handling, properties at the heat-sensitive transfer step, and ease in separating the substrate 11 from the print section retransferred on the final receiving member after heating and pressing step.

Materials of the hot-melting type adhesive layer 14 coated on the base sheet 11 of the transfer sheet 10 must be selected in order to provide an ink-philic property which

ensures a high quality ink image on the hot-melting type adhesive layer 14 without blur, blot, collapse and the like. Further, the adhesive layer 14 must provide high surface smoothness without any surface irregularities. Moreover, the hot melting type adhesive layer 14 must be transparent so that the ink image is visible through the layer 14, since as described above the ink image as well as the layer 14 are finally formed over the receiving member 30, and the ink image is positioned below the layer 14 in the final image retransferred state.

Furthermore, the hot-melting type adhesive material must be selected in due consideration of factors which may affect a quality of the finally retransferred print image after heating and pressing step. These factors are the quality of image per se, touch and feeling, sense of incompatibility, brilliance, fastness against washing, fastness against light beam, fastness against sweat, fastness against dry-cleaning, and amount of free formaldehyde.

According to these factors, the hot-melting adhesive for the adhesive layer 14 can be selected from one or at least two of thermoplastic resins such as polyolefin resins, polyurethane, ethylene-vinylacetate copolymer, ethylene-ethylacrylate, ethylene-acrylic acid, ionomer, polyester, polyamide, acrylic resin, and so on.

At the heating and pressing step, the temperature of

the heating means is 100°C to 250°C which range corresponds to the heating temperature of iron commonly used for house work. More preferably, the temperature should be limited to from 100°C to 200°C in consideration of safety in use, thermal resistance of the base sheet, applicability of the receiving member such as synthetic fibers and plastics to be transferred with the print image. The pressure of the pressing means is 10 g/cm^2 to 500 g/cm^2 depending on the pressure of the iron in family use, and preferably limited to from several twenty or thirty g/cm^2 to at maximum 200 to 300 g/cm^2. The period for the heating and pressing work is 5 to 30 sec. Thus the hot-melting type adhesive layer 14 must be made of a material so that the hot-melting type adhesive layer 14 can be softened and adhered to the receiving member under these conditions.

As described above, the transfer sheet 10 is formed with the any desired ink image transferred by the thermosensitive image transfer type recording device and then discharged from the device as a print sheet 20. As shown in Fig. 1 this print sheet 20 includes transferred ink characters or pictures 21 in a mirror image or a real image.

The print sheet 20 is set on the image receiving member 30 to be printed, as shown in Fig. 4, so as to face the ink image 21 to the print position of the member 30, and then the heating and pressing means 31 is applied to the

rear surface of the sheet 20. The ink image 21 and the hot-melting type adhesive layer 14 are finally transferred to the print position by this heating and pressing transfer work. Then, the base substrate 12 of the transfer sheet 10 is removed from the hot melting type adhesive layer 14, so that the transferred print image 41 is visible. Fig. 1, shows one example of the printed product 40 with the print image 41, and Fig. 5 is a cross-sectional view of the printed product 40 in which the transferred print image 41 composed of the ink image 21 and the hot-melting type adhesive layer 14 is formed on the material 30 by heat and pressure. The ink image 21 is meltedly secured on the surface of the material 30 and in the textile thereof, and to the hot-melting type adhesive layer 14 which is also meltedly and strongly secured on the surface and in the textile of the receiving member 30.

Next, various Examples of the present invention will be described to further clarify the merits of the invention.

Example 1

The ink image formed on the transfer sheet was re-transferred to a T-shirt made of 100% cotton by a hot-stamping under the condition of temperature of 150°C, pressure 200g/cm^2, and stamping period of 10 seconds. Thus formed print image on the T-shirt had a high quality without blot, blur, collapse, and the like. Further, the print image

showed a good appearance with brightness, and provided a good touch feeling without incompatible sense.

The print image on the T-shirt was tested on fastness against washing, abrasion, sweat, dry-cleaning, and light beam, and amount of free formaldehyde by Japan Synthetic Textile Inspection Institute Foundation (JSTIIF).

The testing modes are defined by Japanese Industrial Standard (JIS) as follows:

Washing Fastness:	JIS L0844-1973, A-2
Light Beam Fastness:	JIS L0842-1971
Sweat Fastness:	JIS L0848-1978
Abrasion Fastness:	JIS L0849-1971
Dry Cleaning Fastness:	JIS L0860-1974

The judgment (grade) was in accordance with JIS L0801.10.

The test provided extremely desirable result as follows:

Washing Fastness		Color fade:	5th grade
		Contamination:	5th grade
Light Beam Fastness			not less than 4th grade
Sweat Fastness	Acid	Color fade:	5th grade
		Contamination:	5th grade
	Alkali	Color fade:	5th grade
		Contamination:	5th grade
Abrasion Fastness		Dry state:	5th grade
		Wet state:	5th grade

Dry Cleaning Fastness Color fade: 5th grade

Contamination: 5th grade

Amount of Free formaldehyde not more than 0.05

The transfer sheet was subjected to a preservation test under the conditions at temperature of 55°C for 24 hours; temperature of 35°C, humidity of 80% for 48 hours; and temperature of -20°C for 24 hours. The test samples exhibited final states the same as their initial states.

Example 2

An ink image was thermosensitively transferred on a transfer sheet which includes a glassine paper provided with a polyurethane resin layer of thickness 50 micron meters through a releasable layer of paraffin wax by a heat-sensitive image transfer type tape writer (P-touch manufactured by Brother Kogyo K.K.) at ambient temperature of 10°C to 35°C. Thus formed ink image was extremely clear and fine.

The ink image formed on the transfer sheet was re-transferred to a handkerchief made of 100% cotton by a hot-stamping under the condition of temperature 140°C, pressure 150g/cm^2, and stamping period 15 sec. Thus formed print image on the handkerchief had a high quality without blot, blur, collapse, and the like. Further, the print image showed a good appearance with brightness, and provided a good touch feeling without incompatible sense.

The print image on the handkerchief was tested on

fastness against washing, abrasion, sweat, dry-cleaning, and light beam, and amount of free formaldehyde by Japan Synthetic Textile Inspection Institute Foundation (JSTIIF). The test provided extremely desirable result. This test results were as follows:

Washing Fastness		Color fade:	5th grade
		Contamination:	5th grade
Light Beam Fastness			not less than 4th grade
Sweat Fastness	Acid	Color fade:	5th grade
		Contamination:	5th grade
	Alkali	Color fade:	5th grade
		Contamination:	5th grade
Abrasion Fastness		Dry state:	5th grade
		Wet state:	5th grade
Dry Cleaning Fastness		Color fade:	5th grade
		Contamination:	5th grade
Amount of Free formaldehyde			not more than 0.05

The transfer sheet was subjected to a preservation test under the conditions at temperature of 55°C for 24 hours; temperature of 35°C, humidity of 80 % for 48 hours; and temperature of -20°C for 24 hours. No abnormality were found after the tests.

Example 3

An ink image was thermosensitively transferred on a transfer sheet which includes a polyester film provided with

a etylene-vinyl acetate copolymer layer of thickness 30 micron meters through a releasable layer of silicone by a heat-sensitive image transfer tape writer (P-touch manufactured by Brother Kogyo K.K.) at ambient temperature of 10°C to 35°C. Thus formed ink image was extremely clear and fine.

The ink image formed on the transfer sheet was re-transferred to a T-shirt made of 100 % cotton by a hot-stamping under the condition of temperature of 130°C, pressure 200g/cm^2 , and stamping period of 10 sec. Thus formed print image on the T-shirt was possessed of a high quality without blot, blur, collapse, and the like. Further, the print image showed a good appearance with brightness, and provided a good touch feeling without incompatible sense.

The print image on the T-shirt was tested on fastness against washing, abrasion, sweat,dry-cleaning, and light beam, and amount of free formaldehyde by Japan Synthetic Textile Inspection Institute Foundation (JSTIIF). The test provided extremely desirable result except for the durability against dry-cleaning. This test results were as follows:

Washing Fastness		Color fade:	5th grade
		Contamination:	5th grade
Light Beam Fastness			not less than 4th grade
Sweat Fastness	Acid	Color fade:	5th grade
		Contamination:	5th grade

Alkali	Color fade:	5th grade
	Contamination:	5th grade
Abrasion Fastness	Dry state:	4th to 5th grade
	Wet state:	5th grade
Dry Cleaning Fastness	Color fade:	2nd grade
	Contamination:	5th grade
Amount of Free formaldehyde		not more than 0.05

The transfer sheet was subjected to a preservation test under the conditions at temperature of 55°C for 24 hours; temperature of 35°C, humidity of 80 % for 48 hours; and temperature of -20°C for 24 hours. The test samples had states the same as their initial state.

As given described above, the printing method according to the present invention ensures that user can easily make the desired print image on the transfer sheet by using the heat-sensitive image transfer type recording device, and thus can reprint the print image formed on the transfer sheet on various receiving members at a low cost in a simple manner. Further, the printing method provides satisfactory effects that any desired letters and pictures can be freely arranged and easily printed on various materials in high quality print image. These advantages will contribute to industrial and home uses.

C L A I M S

1. A printing method for printing an image on an image receiving member comprising the steps of:

transferring an ink image onto a transfer sheet comprising a hot-melting type adhesive layer to provide a print sheet; and

retransferring the ink image and the hot-melting type adhesive layer onto the image receiving member by heatedly pressing the transfer sheet to thereby provide a final print on the receiving member.

2. The printing method as claimed in claim 1, wherein the transfer sheet comprises a base substrate, a releasable layer formed on the base substrate and the hot-melting type adhesive layer formed on the releasable layer, and wherein the ink image is transferred onto the hot-melting type adhesive layer at the first transferring step, and the retransferring step further comprising the steps of removing the base substrate together with the releasable layer from the hot-melting type adhesive layer.

3. The printing method as claimed in claim 2, wherein the base substrate is a sheet like material comprising a paper or metal foil or a laminated film.

4. The printing method as claimed in claim 2 or 3, wherein the releasable layer is formed of at least one material selected from a group consisting of silicone resin,

fluoro resin, polyolefin resin and paraffin wax.

5. The printing method as claimed in claim 1, 2, 3 or 4 wherein the retransferring step is carried out at a heating temperature ranging from 100 to 250°C, pressure ranging from 10 to 500 g/cm^2, and pressing period of from 5 to 30 seconds.

6. The printing method as claimed in claim 1, 2, 3, 4 or 5 wherein the hot-melting type adhesive layer is made of at least one thermoplastic resin selected from the group consisting of polyolefin resin, polyurethane, ethylene-vinylacetate copolymer, ethylene-ethylacrylate, ethylene-acrylic acid, ionomer, polyester, polyamide and acrylic resin.

7. The printing method as claimed in any one of the preceding claims, wherein the hot-melting type adhesive layer is formed of a transparent material.

8. A printing method substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

9. A transfer sheet for use in a method according to any one of the preceding claims.

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